UNIVERSITY OF CALIFORNIA

THE JUNIOR COLLEGE IN CALIFORNIA

A CIRCULAR PREPARED BY THE COMMITTEE ON COURSES OF INSTRUCTION OF THE UNIVERSITY OF CALIFORNIA

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PREFATORY NOTE

In April, 1914, the Committee on Courses of Instruction was requested to take up the matter of junior colleges and their relation to the University. Accordingly, statements were collected from the University departments concerned. On the basis of these statements a preliminary report was prepared. This report and the department statements were then submitted to the junior-college faculties by the Dean of the Graduate School. Comments and suggestions were requested, together with complete statements concerning curricula, equipment, and faculties. The material thus collected was then submitted to University departments with a request for criticism and for suggestions. These suggestions are now published in Part II of this Circular and form the basis of the general discussion in Part I.

In preparing Part I use has been made also of the following articles: *The Extension of the High School Course,* by Frederick Liddeke, *Sierra Educational News,* June, 1914; *The Junior College,* by C. L. McLane, *School Review,* vol. 21, p. 161; *Report of the Commissioner of Secondary Schools to the State Board of Education,* by Will C. Wood, June, 1914; *The Upward Extension of the High School,* by C. C. Starr, in C. H. Johnson's *Modern High School,* p. 829. Occasional reference has been made to the regulations adopted in March, 1914, by a committee of the College Section of the State Teachers' Association of Texas, defining the minimum conditions that should exist before a school can be classified as a junior college or a college; to the regulations published October, 1912, governing the accrediting of junior colleges by the University of Missouri; and to the regulations adopted in June, 1914, governing the accrediting of junior colleges by the University of Illinois. It is believed that the standards suggested by the present Circular will not seem unreasonably high as compared with those of Texas, Missouri, and Illinois.

In addition to the documents named above the editor has had the privilege of consulting reports to the Committee on Courses of Instruction by the Dean of the Graduate School and the Director of the School of Education, together with an unprinted paper by the latter on *Junior College Problems,* and an admirable discussion of specific questions in a report by Mr. Wilfred Eldred to the San Diego Board of Education. From all these documents he has borrowed freely. He is indebted furthermore, to a Master's thesis on *The Junior College,* by A. A. Gray, now in the University of California Library.

The present Circular is thus not the work of any one individual; and it is not a product of the University alone; it is rather the result of a co-operation of the junior-college faculties with the faculty of the University. It aims to consider junior-college problems from both points of view. And if, now and then, it attempts solutions of these problems or ventures to decide questions one way or the other, its solutions and decisions are to be regarded as suggestive rather than as final. For the whole matter, in every aspect, is in a state of transition. The junior college stands at the very beginning of its career; and the lower division of the University is undergoing important changes and facing many unsolved problems of its own. It has been with the utmost reluctance that many departments have committed themselves to definite statements of policy or advice.

PART I. THE JUNIOR COLLEGE

INTRODUCTORY

In an unpublished address on *Junior College Problems,* Professor A. F. Lange sketches the history and outlines the aims of the junior college as follows:

"In 1907 the California Legislature passed an act enabling the high-school board of any high-school district to add two years to the traditional four-year high-school course.[1] In 1910 the Fresno High School was so extended. By the end of 1914 there were ten such extensions, commonly known as junior colleges, with an enrollment of about 700 students. Meanwhile, this so-called California Idea has been institutionalized several times over elsewhere.

"The rise and progress of the junior college must be regarded as an integral phase of a country-wide movement toward a more adequate state system of education, a system that shall function progressively so as to secure for the nation the greatest efficiency of the greatest numbers. The evolution of the junior college is causally connected with the other constituent phases of the whole process of reorganization and adaptive changes. It is inseparable from three of these: (1) the adjustment of the university, in the Germanized sense, to secondary education; (2) the reorganization of secondary education, to make it more effective, for all alike, during the whole period of adolescence; (3) the movement to equalize educational opportunities by the creation of lower and middle systems of vocational training. In the light of this situation the junior college appears as a normal development within a state school system in the making, and this in turn is itself being shaped largely by factors and forces that are national and even world-wide in scope.

"Since 1892 the University has been gradually reshaping itself around two organizing ideas. One was and is that for theoretical and practical considerations alike, the university proper should begin in the middle of the inherited four-year college scheme; the second was and is that the work of the first two years is as a matter of history and fact

[1] "The high-school board of any high-school district, or trustees of any county high school, may prescribe postgraduate courses of study for the graduates of such high school, or other high schools, which courses of study shall approximate the studies prescribed in the first two years of university courses. The high-school board of any high-school district, or trustees of any high school wherein such postgraduate courses of study are taught, may charge tuition for pupils living without the boundaries of the district or county wherein such courses are taught."

all of a piece with secondary education. This trend of thought and preaching and practice resulted *gradatim* in the Junior Certificate, to mark the distinction between university and secondary education, in the policy of placing all professional schools on a basis of not less than two years of non-professional training, in making the studies of the last two years of the high school and the first two of the college largely interchangable, and, last not least, in publicly exhibiting the requirements for the Junior Certificate in terms of unified six-year curricula.

"With this university movement two others coalesced. One had its source in the now dominant conviction on the part of leaders in educational thought that for the great majority of boys and girls undergoing secondary school training the American four-year high-school course begins too late and ends too early. A remedial readjustment, it has been seen for some time, must consist in the lengthening for all concerned of the courses for adolescents. In California the upward extension of the high school was urged in the educational interest of the great mass of high-school graduates who cannot, will not, should not become university students. Such an extension, it was argued, might and should make it possible for the small minority to enter a university, in the narrower sense, at the end of two years; but the controlling educational purposes should be to provide for a reasonably complete education, whether general or vocational. The other movement had its source in the increasingly imperative need of vocational training, first of all for those whose education for general social efficiency is not prolonged beyond the elementary school, and, secondly, for those whose general education ends with the four-year high school period and who are not headed for one of the professions, in the restricted sense. With reference to this need too, as far as the latter class is concerned, an additional two years came to appear desirable and necessary, for 'finishing courses' in applied science of one sort or another, according to local means or demand. Moreover, it seemed clear from the university point of view, that such departments might render a great service to the universities and to thousands of young people, by diverting them from the university and thus preventing their becoming "misfits" for life.

"It is of course an inevitable phase of development that as yet not one of the junior colleges has fully found itself. But even now the uncertainty that exists relates rather to matters of organization and method than to fundamental conception and aim. It is coming to be generally understood that the junior college cannot serve its complete purpose if it make preparation for the university its primary object. For the great majority of junior-college students, courses of instruction and training are to be of a piece with what has preceded; they are to be culminal rather than basal. The junior college will function adequately

only if its first concern is with those who will go no farther, if it meets local needs efficiently, if it turns many away from the university into vocations for which training has not hitherto been afforded by our school system. Hence it will of necessity be as nearly autonomous as its place in the public school system of the State permits; and its structure will normally exhibit two types of departments,—(a) departments designed to promote general social efficiency, (*b*) departments designed to furnish complete training for specific—or vocational—efficiency.''

In regard to the further development of the junior college Mr. Wilfred Eldred asks pertinently:

''Shall every high school in the State look forward to the time when it shall be a six-year high school, or should we have colleges only in those cities which have already developed their primary and secondary school systems to a point of reasonable efficiency, and which can undertake to give the more advanced work with reasonable prospect of success, having in mind not merely the demand for such work, but also the resources available to do it? For it must never be lost sight of that the junior college is going to mean a greatly augmented expense, added to a system of education already expensive. How many of our cities are yet in a position to face these extra costs? Probably not more than a dozen in the entire state.''

Mr. Will C. Wood sees a double danger in attempts of ambitious communities to establish junior-college classes without the means necessary properly to maintain them.

''The high school may be weakened to strengthen the 'college' courses, or the college courses may be given under such unfavorable circumstances that they will not be worth while. It may be that legislation limiting 'junior-college' courses to districts having a fixed minimum of assessed valuation, or to high schools having a fixed minimum of enrollment, will be necessary.''

Four or five of the institutions that have tried junior-college work are already finding it impractical to continue, first for financial reasons, secondly because it is impracticable to combine in the same institution junior-college and high-school instruction. The chief difficulties lie in the arrangement of the periods, the assignment of credit in mixed classes, the segregation of high school and junior college faculties.

Financial difficulties aside, the main problems of the junior college seem at the present writing to lie in Faculty, in Equipment, in Curriculum, in Relation to High School and to University. In the following pages these problems are discussed, first, in general, and, secondly, from the points of view of the separate University departments.

THE FACULTY

As in any institution of learning the chief problem will always be the problem of the teaching force. It is generally recognized that the work of junior-college grades is beyond the qualifications of the rank and file of high-school teachers. Certainly it is desirable that the junior-college teacher should have had some experience in university instruction—just as it is desirable that the university teacher should have had some experience in secondary work. And certainly the junior-college teacher should not be inferior to the university instructor with respect to advanced scholarship.[2] This means that he should have devoted two or three years to graduate study in his chosen field, that he should be a specially trained expert, should have done work equivalent to that usually required for the doctor's degree. The degree itself is not a *sine qua non*—many great scholars have contrived to achieve eminence without it; but the habit of mind, the general attitude toward knowledge which results from training like that which leads up to the degree—this is indispensable. The "young doctor of philosophy" as a teacher of undergraduates is so often maligned that a word in his defence may not be out of place. Not uncommonly he has taught for some years, either while carrying on his graduate work or before entering upon it. Frequently he has had the advantage of study in more than one institution and contact with a variety of minds and environments; he has observed with intelligent appreciation the methods of great teachers. He is, it is true, a specialist; but he is not necessarily a narrow one. He was a bachelor before he was a doctor, and if he lacks breadth of training, if he has not had a liberal education, the fault lies with his course as an undergraduate rather than as a graduate student. Moreover, though his thesis may have dealt with a minute sub-division of his field, yet he has been obliged, for his final examination, to review, as a whole, the field of major and minor subjects alike, to study the relation of part to part, to mobilize a whole body of knowledge. This is a most stimulating experience; and at no time does a man have a livelier enthusiasm for his subject or a more effective or more contagious sense of its possibilities. His devotion to it and his proficiency in it are attested by his degree. Certainly an inhuman specialist is not fitted to teach undergraduates of any grade, least of all Freshmen and Sophomores, whether in a junior college or a university. For such work the instructor should be specially equipped for intimacy with students; he should be the kind of man a small college would select. But, provided that he

[2] In Texas, "the equipment of the teachers should be approximately equal to that of college teachers." In Missouri, "it is desirable that they should have completed one year of graduate work."

has these qualities of character, he is the better and not the worse for the doctor's degree. The employment of specially trained men, moreover, is desirable not only from the junior-college but from the university point of view. A steady demand for them will inevitably increase the supply; and while the encouragement of higher learning can never be one of the main functions of the junior college, it may well become an important by-product of its activity.

Trained and experienced teachers will always be more difficult to secure than untrained and inexperienced ones. They will, of course, command higher salaries. It is not, however, wholly a matter of salary. Opportunity to carry on research not only in the narrow field of some special interest, but also in the art of teaching the chosen subject in its broader outlines and more elementary aspect will have great weight. To this end it is essential that the hours of instruction should not be more than twelve or, at most, fifteen, per week[3]—not because it is the business of the junior college to foster research, but because it is the business of the junior college to get the most out of its teachers, to give them opportunity for life and progress, in order that their teaching may be effective and that they may preserve the scientific attitude toward their work. With the same end in view liberal provision for laboratories and libraries is essential. In many fields of work it should be possible for an instructor to add to the sum of human knowledge with no more equipment than that which might properly be expected of a junior college. In all fields it should be possible for him to keep abreast of the best thought on the methods of imparting his subject, to devise and to elaborate new methods of his own, making of his class-room a laboratory for well-considered experiments in the art of teaching. It should be possible for him to follow the example of his colleagues in the French *lycées* and the German *gymnasien*, and to publish his results, whether in the field of pure knowledge or of professional applications, with obvious benefits to himself and to his college. Exchange of instructors between junior college and university has been suggested by members of both institutions. A beginning has been made in the summer-session faculties, which already include teachers from secondary schools. The practice would have obvious advantages for all concerned, provided always that the instructor in each case be fitted to carry on precisely the sort of work required, whether by the university or by the junior college. Occasional identification with a university, contact with university atmosphere, access to laboratories

[3] In Missouri, "there must be a sufficient number of teachers to conduct the work without crowding the classes, or without assigning to individual teachers an excessive amount or variety of work." In Texas, "no teacher should be required to do more than twenty hours per week of class-room work." In Illinois, there is a similar limitation.

and libraries—this, combined with adequate salary, leisure and equipment for research, would go far toward making the junior college attractive to scholars.

So far as the duties of the instructor are concerned, it is generally agreed that these should not be restricted to the junior college, but that part of his time should be given to high-school courses. Under present conditions, and, generally, in the beginning, there can hardly be enough work in one subject, in the junior college alone, to require an instructor's full time. Usually additional high-school courses in his own subject will be more desirable for him than additional junior-college courses in other subjects. However, it will mainfestly make for continued breadth, without scattering, of interest, if, as in Germany, the instructor teach his major subject in the highest classes and his minor subjects in the lower classes. At present the head of the high-school department undertakes courses in the junior college. This practice seems to work well. Certainly the head of the department should be the same for high school and junior college.

Experience thus far seems to show, also, that there should be one and the same head or principal for high school and junior college. It has seemed wise, however, to entrust to a specially appointed dean the supervision of matters concerning the junior college alone. The duties of such an officer will be similar to those already performed, in part, by the vice-principal in certain California high schools. They will be more or less analogous to the functions of a university dean of the lower division. The dean of a junior college will act as guide, philosopher, and friend to the students; enter, as far as possible, into their athletic or social as well as their academic activities; advise with them in regard to choice of courses and conduct of life; concern himself with such questions as the housing problem (which the junior college will have sooner or later to face as it attracts students from other districts) and with the general policy and special needs of the junior college. Mr. Wilfred Eldred observes that the dean should not have the autocratic powers of the American college president. But certainly he should have a voice in the appointment of teachers, and, indeed, their selection might well be largely in his hands, since he will be in the best position to know what type of instructor is most likely to succeed in his institution. It is desirable, again, that he should be familiar with the institution as a whole; he should conduct classes in the high school as well as in the junior college; he cannot form too early the acquaintance of the students whom he is to advise. Upon him will depend in large measure the success of the junior college.

EQUIPMENT

Detailed estimates of the cost of laboratory and library equipment are included in the department suggestions in Part II of this Circular.[4]

Where it is desired to emphasize the distinction between the junior college and the high school, the special junior-college equipment should include separate class-rooms, or better, a separate building. "Removing the mere physical contact with the old and familiar high-school corridors and their inmates," thinks Mr. Eldred, "would go a long way toward stimulating a different habit of mind." Mr. Eldred declares also for the separate reading-room for junior-college students, an arrangement already established in several institutions.

CURRICULUM

What departments of instruction are to be represented in the junior college will depend in large measure upon local conditions—upon local demand, upon the presence of properly trained and experienced teachers, upon adequacy of equipment, and upon funds to increase faculty and equipment whenever such increase may be necessary. Manifestly, modest beginnings are advisable. It is the part of wisdom to undertake at first to cover only the ground of the Freshman year, and this only in departments that require little or no equipment beyond that of the average high school, such as English, foreign languages, ancient and modern, history,[5] mathematics,[5] chemistry, and economics. A second tentative step might be to offer, in alternation, additional courses in some of these same departments, such as English and history, where the order of courses is not rigidly fixed as it is in mathematics. This could be done without further addition to the teaching staff. Provided that properly qualified instructors are obtainable, or already at hand, it will not be difficult for the high school to offer a single additional year of general education. Its other important function, to provide "finishing"

[4] The University of Missouri requires that "there must be a laboratory for physical science and a laboratory for biological science, each adequately equipped and sufficiently large to permit easily of individual work upon the part of the students." Texas has a similar requirement and states that sufficiency is "to be measured by the value of the apparatus, which shall be, in chemistry not less than $1000, in physics not less than $2000, in biology not less than $1500." Missouri insists on "adequate library equipment;" Texas, on "a library of not fewer than 2000 volumes bearing specifically upon the subjects taught."

[5] See, however, the recommendations of these departments below, pp. 36 and 43.

vocational courses in agriculture, in the industries, in applied civics, in commerce, in domestic science, etc., which cannot be adequately provided either by the high school or by the university—this other function may well be cautiously undertaken at the same time, but only where proper instruction and library or laboratory facilities can be provided.

Detailed suggestions in regard to courses in these and other departments will be found in Part II of this Circular.

THE JUNIOR COLLEGE AND THE HIGH SCHOOL

If one reason for the existence of the junior college is the fact that the natural break in education comes after the end of the Sophomore year and not before the beginning of the Freshman year, it is obviously illogical to place much emphasis upon the distinction between the high school and the junior college. Junior college and high school are one single institution. But it is a highly developed institution; it has come a long way on the road from the homogeneous to the heterogeneous; and if the junior college is a part of it, it is an organic part, with distinct and special functions to perform. Ideally, both identity and dissimilarity should be emphasized; the principle of unity in variety should be applied. It is applied in the single head for the whole institution and the separate dean for the junior college; in the control of each department by a single head for junior college and high school alike; in the special faculty for the junior college, giving instruction, however, in the high school; in the resulting program, unified, yet with new attitudes and methods for the junior college. For it is clearly desirable that, as required in Illinois, "the junior-college courses should be organized and conducted on a collegiate as distinguished from a high-school basis. College texts should be used and should be supplemented with reference or other outside work of collegiate character, and the amount of ground covered in a semester should approximate that covered in corresponding college courses." The same conception of the junior-college course is contemplated in the California law, which states that "the courses of study shall approximate the studies prescribed in the first two years of university courses."

It does not seem necessary that junior-college students should be excluded from all high-school courses. The University of California regards the last two years of the high school and the first two of the college as largely interchangable, and has found it necessary to offer a number of courses equivalent to matriculation subjects, designated, in the ANNOUNCEMENT, by letters instead of numbers, such as German AB,

French AB, Mathematics A, etc. Such courses are appropriate in the junior college, in the lower division of the university, or in the high school. Certainly the student should be permitted to take them at any time before his junior year, or even later, should the need arise.

Admission of high-school students to junior-college courses is another matter. In general, it is clearly desirable that such courses should be regarded as more advanced, should employ methods implying greater maturity, should be, in a word, beyond the powers of high-school students. If these are freely admitted, standards and methods will inevitably suffer. Yet it is conceivable that occasional exceptions can be made with perfect safety. In the universities exceptional students in the lower division are admitted to upper-division courses, and exceptional undergraduates to graduate courses. Such exceptions will depend on the individual student, on the nature of the course and its methods, and on the instructor. The regulation of the University of Illinois suggests a definite solution of the problem: "The admission of high-school students to junior-college classes should be limited to students of senior standing and of superior scholarship, 'superior scholarship' being interpreted to mean a rank within the first third of the class. The number of even these picked high-school seniors in any junior-college class should not in any case exceed one-half of the total membership of that class and should ordinarily be limited to one-third the total membership of the class." In the University of California an extremely useful rule is the Faculty regulation to the effect that "no student will be permitted to enter upon the study of any subject if the officer of instruction in charge of that subject is satisfied that by reason of lack of preparation he is not competent to undertake it. This rule takes precedence of all others." Such a rule would be an admirable safeguard in junior colleges where exceptional high-school students are permitted to enter certain junior-college classes.

In the interest of high standards it is well that only such junior-college students as can, on entering, satisfy university requirements, should earn university credit.[6] Yet here again exceptions can be made with safety. It is quite possible that an occasional student may finish the high-school course with scholarship records which would not warrant admission to the Freshman class of the University, yet may, in the junior college, by faithful and consistant study, prove himself ready for advanced work. There is no reason why such a student should not be recommended for admission to the upper division of the university.

[6] The University of Missouri accredits only those junior colleges whose requirements for admission are "the equivalent of those of the College of Arts and Science of the University of Missouri." In Texas, the junior college must "require not less than fourteen standard units for entrance."

In making a recommendation of this sort the junior college may render an important service to the type of mind that wakes relatively late to the importance of study, pursuing it then with all the greater seriousness and vigor. Yet the junior college will manifestly have to proceed with caution; it cannot afford to lower its standards.

One way to emphasize the real distinction between junior-college and high-school work is to make the change from the five recitation periods of forty minutes each (or from four of fifty) to three periods of one hour each. University experience everywhere shows that the full hour—or what is left of it after the necessary intermission—is none too long for the proper development of the theme of lecture or recitation. The change, moreover, involves an increase in the time available for preparation and a decrease in the time spent in recitation. Only a few minutes are involved, yet the effect of the change is important, in that it shifts, to a certain degree, the responsibility from teacher to student; it begins the transition from the school attitude to the college attitude. However, the whole question is in part a matter of departments and courses. In the University of California, for example, while three periods per week is the rule, the modern language departments very decidedly prefer five periods per week for their beginners' courses; and in certain courses in English and history three hours of lecture and one of quiz seem to give the best results. In Part II will be found the special recommendations of a number of University departments. It will be found that one hour is in most cases tacitly assumed as the proper length for recitation or lecture.

The normal University schedule is sixteen units (or sixteen hours per week) per half year. Students in the lower division are not permitted to register for more than nineteen units each term.[7]

A University rule requires that an examination be given at the end of all courses, except seminar and laboratory courses. From these examinations no students are excused. A similar rule is desirable in the junior college, where the examination may not be necessary to discover what the students know, yet may well perform its more important function of compelling a review and grasp of the subject as a whole.

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[7] The University of Missouri requires that for graduation from the junior college "the student must complete satisfactorily sixty hours of work, which must be the equivalent of that required in the first two years in the College of Arts and Sciences in the University of Missouri By an hour is meant a 60-minute period of class work, or a 120-minute period of laboratory work (exclusive of preparatory instruction and study, work upon note books that can be done outside of laboratories, etc.), each week for one semester.

"Students shall not be allowed to carry for credit work amounting to more than sixteen hours a week."

The Texas rule is "fifteen 60-minute hours per week of recitation each year."

THE JUNIOR COLLEGE AND THE UNIVERSITY

The main concern of the junior college will always be with students who complete in it their education. Doubtless the number of those who go on to a university will always be relatively small, as will, similarly, the number of junior-college graduates in the upper division of the university. Neither institution should lay too much stress on their mutual relation as a factor in determining educational policy; each should be willing to make such necessary adjustments as may be possible. So far as general preparation is concerned, junior-college students have already given evidence of being well equipped to continue their studies in the upper division of the University of California. The average of their grades has been slightly higher than the general University average. They have not, however, been always prepared for precisely the work which they have desired to undertake; in such cases a certain loss of time is inevitable. Instructors in the University have the right, and are indeed under obligation, to refuse to allow any student to enter upon work for which he is not competent, to attempt to erect a superstructure on a foundation incapable of supporting it. It should not be necessary to explain that this principle exists for the protection not so much of the University, or of any University department, as for the protection of the student himself.

The policy of the University of California with reference to students entering from junior colleges is formulated by the Recorder of the Faculties as follows:

> It is the University's policy to give a year's credit for a year's work on the basis of credentials from other colleges, including junior colleges. Wherever there is evidence that the institution is doing a full year of work beyond the high school, the University will endeavor to give 32 units (slightly more in the engineering colleges) and to distribute these 32 units in a way that will equitably meet requirements for the junior certificate and the bachelor's degree.
>
> The normal university schedule of 16 units per half-year implies about 48 hours per week of studious effort for 18 weeks. We have estimated that the junior colleges as they are at present organized (and, in general, they seem to be mainly projections of high-school schedules and standards rather than distinctively collegiate institutions according to the prevailing conception of a college) may complete 32 units per year by requiring five courses concurrently, each class meeting five periods per week in 40-minute periods throughout a 20-week semester. The same result may be obtained by having the classes or some of them meet four periods per week, the periods to be 45 or 50 minutes and the amount of outside preparation for the class work to be proportionately greater than would be required if the meetings were five times weekly.

There is, of course, some danger in the situation so long as the University's test of the applicant's proficiency is primarily a time test, rather than a knowledge test. But the real unit for the application of the time test should be the unit of studious endeavor in or out of class, rather than the aggregate of hours or minutes spent in the class room.

For a five-study schedule, such as is indicated above, continued for two years, we should expect in the ordinary case to give 64 units of credit. The units of credit assigned to a single subject continued for one year would be six. To make the two-year schedule yield 64 units we may either assign 8 units for certain subjects or we may arbitrarily add 4 units of elective undistributed.

The successful articulation of junior-college work with university work will naturally depend very largely upon the extent to which the junior college is able to meet the varied departmental requirements of a large university. In some highly specialized departments it may be difficult for the junior college (as for any small institution) to afford adequate preparation. An example would be the field of engineering. Similarly, the work that is now required of pre-medical students (college laboratory courses in physics, chemistry, zoology, bacteriology, etc.) is not easily obtainable outside of the universities. Architecture and agriculture are in a similar position.

Definite statements of department requirements will be found in Part II of this Circular.

Attention is called to the fact that the content of lower-division university courses is by no means determined by the whim of the instructor, or by the mere fact that they are prerequisite to advanced courses in the same departments. It is determined in a large measure by the fact that they are prerequisite to advanced work in other departments as well. Many lower-division courses have thus complex functions to perform and must be carefully planned with these in view. A list of such courses follows, based upon the ANNOUNCEMENT for 1914–15. The requirements vary somewhat from year to year, and junior colleges which desire to offer courses which shall prepare students for the University are urged to obtain the latest information in every case. The present list, however, should serve to illustrate the complexity of the interrelations of University departments, as well as to emphasize the importance of certain courses as prerequisites.

(For Matriculation Courses, see CIRCULAR OF INFORMATION, Admission Requirements: Recommendations for the various curricula. In general, Lower-Division Courses are prerequisite for Upper-Division Courses in the same department.)

Astronomy — 1 and 2A are required for the Major in Geography and for Geography 114.
3 is required for Civil Engineering 103B and 105.

Botany

Botany is advised for Landscape Gardening. 1 (or 2 and 3) required for Forestry 102.

2 and 3 required for Agronomy 107, 122; for Forest Botany; for Genetics 1, 1A, and 100; for Landscape Gardening 104A–104B, 102A–102B; and for Pomology 120.

Chemistry

Fundamental Courses in Chemistry should precede Botany.

1A–1B is required for Agricultural Chemistry 1 and 2; for Agronomy 122; for Nutrition 117; for Botany 116; for Mechanical Engineering 118; for Mining 105, 107A; for Pathology 1; for the Major in Physiology, for Physiology 5; and for the Medical School.

3A–3B is required for Soils 122.

5A–5B is required for Agricultural Chemistry 101A–101B, 122; Soils 122; Civil Engineering 122.

6A–6B is required for Civil Engineering 123; Mining 105, 107A.

8A is required for Civil Engineering 109B; 111B, 126, and for the Medical School.

9 is required for the Medical School.

Civil Engineering

Courses in Civil Engineering are advised for Landscape Gardening.

1A–1B (Surveying) is required for Mining 18A and 18B.

1A–1C or 1E is required for Experimental Irrigation 1; for Astronomy 3; and for Irrigation 105.

1C–1D is required for Mining 18A and 18B.

Drawing

Courses in Drawing are advised for Landscape Gardening.

2A is required for Mechanical Engineering 106A; and for Architecture 101A–101B.

2B is required for Architecture 101A–101B.

Economics

1A–1B is required for Jurisprudence.

English

Training in English Composition is required for the Subject A Examination (See CIRCULAR OF INFORMATION, Subject A).

Certain courses in English are advised by the Department of Jurisprudence.

French

French may be used to satisfy the Subject B requirement (CIRCULAR OF INFORMATION, Subject B). A reading knowledge is assumed in many advanced courses in History, and is eminently desirable for German, Latin, English, Botany, Landscape Gardening, and Zoology.

Geography

1A (or Geology 1A) is required for Soil Technology 1; for Economics 3A; and is advised for the Major in Economics.

Geology

1A (or Geography 1A) is required for Soil Technology 1; for Geography 115; Mining 101, and recommended for Astronomy.

German

German may be used to satisfy the Subject B requirement (CIRCULAR OF INFORMATION, Subject B). A reading knowledge of German is eminently desirable for Landscape Gardening, Botany, Economics, English, Latin and Physics. It (or a reading knowledge of Spanish) is assumed in advanced courses in History.

Greek

Greek may be used to satisfy the Subject B requirement (CIRCULAR OF INFORMATION, Subject B). A knowledge of Greek is desirable for the advanced study of Latin, English, French, and German.

History

1A–1B is required for Jurisprudence.
Ancient History is desirable for Latin; Modern European History, for the Romanic Languages.

Latin

Latin may be used to satisfy the Subject B requirement (CIRCULAR OF INFORMATION, Subject B). Latin is necessary for the study of the Romanic Languages, and very desirable for advanced study of Botany. Six units are required for Jurisprudence. Twelve units may be offered in place of certain linguistic courses to fulfill the requirements for the Major in English.

Mathematics

Higher Mathematics is desirable for Botany.
1, 2, 3, 4, are required for the Engineering Colleges; 3 and 4 (or 5, 8 and 9) for the Major in Astronomy.
2A–2B is advised for Economics.
3A–3B is required for Electrical Engineering 1B; for Physics 107A, 109A, 213.
3B for Mining 103A.
4 (or 109) is required for Astronomy 108; for Mechanical Engineering 102; for Physics 107A, 109A, 213.
4A–4B, for Civil Engineering 108A–108B, 110; Mechanical Engineering 102, 110A–110B.
5 is required for Astronomy 103A, 104A, 114.
9 is required for Physics 107A, 108, 109A, 213.

Mineralogy

1A–1B is required for Geology 102A–102B, 102C–102D, 103A–103B, 107, and for Mining 105, 107A.

Palaeontology.

1 is required for Geology 1B.

Pathology

1 (Bacteriology) is required for Soils 122; for Veterinary Science 119; and for Civil Engineering 111B, 126.

Philosophy

Courses in Philosophy are advised for Jurisprudence.
1 and 2A are advised for Economics.
2A and 2B are required for the Major in Education and for Education 103A, 106, 110, 111.

Physics	Fundamental courses in Physics should precede the advanced study of Botany. 1A–1B and 2C–2D are prescribed in the Colleges of Engineering. 1A–1B is required for the Major in Astronomy and for Astronomy 103A, 104A, 114; Chemistry 111A, 113A; for Civil Engineering 108A-108B; for Irrigation 105; for Mining 103A, 105. 2A–2B (or 1) is required for Irrigation 105 and by the Medical School. 2C–2D is required for Chemistry 111A, 113A; for Mechanical Engineering 1B; 110A–110B, 118; for Mining 105. 3A–3B, 4A–4B are required by the Medical School.
Physiology	Physiology is advised for students of Botany. 1 is required for Poultry Husbandry 101, Physical Education 104; and is an alternative requirement for the Major in Education.
Political Science	1A–1B is required for the study of Economics and of Jurisprudence.
Spanish	Spanish may be used to satisfy the Subect B requirement (CIRCULAR OF INFORMATION, Subject B). A reading knowledge of Spanish or German is convenient in certain advanced courses in History.
Zoology	Zoology is advised for students of Botany. 1A or 1B is required for Genetics 1A, Genetics 1, Poultry Husbandry 101; for Palaeontology 1, 104; for Physiology 110, and is an alternative requirement for the Major in Education. 1A and 5 are required for the Medical School.

The foregoing list shows very clearly that the lower division is at present an organic and necessary part of the University of California. It is desirable that it should remain so for many years to come, that lower-division courses should continue to be conducted as part of the University curriculum, with standards automatically upheld by their relation as prerequisites to courses in the upper division. Prophets who look forward to the time when the junior colleges will take over the whole of the work of the University Freshmen and Sophomore years look far into the future. At the end of his high-school course the student will long continue to have the privilege of choosing between the junior college and the University.

The choice will not be an easy one; there will be many advantages on both sides. On the one hand, the junior college makes possible a completed vocational or general education for students who cannot afford to travel or to live far from home, or who do not wish to sever family ties. It enables the young or immature student to postpone the moment

of facing the problems incident upon life in a great university. It offers to the student who has failed to get his recommendation for college another opportunity to prove himself, by faithful and consistent study, capable of advanced work. It has the great advantage of small classes; and, so long as it excludes high-school students from them, of homogeneous classes of a high level of preparation. It has, at its best, the advantage of employing experienced specialists in the art of teaching. And, finally, the junior college may hope to escape in a large measure the evils of the so-called "student activities."

For many students, clearly, the junior college will be preferable to the lower division of the universities. But not for all. Mr. C. L. McLane very wisely remarks that[8] "in many instances it is desirable that a student have a new environment—a new setting, so to speak—to give new zest and an added stimulus to his efforts. Even though a local institution offers equal advantages, it is often desirable to throw the young high-school graduate on his own responsibility for a time by severing home relationships." And President Lowell states[9] that statistics compiled at Harvard College show that at that institution "the men entering college young are on the average better, both in their studies and in their conduct. . . . The advantages, indeed would seem to be almost wholly in favor of entering college young. . . . The real pleasures are more fully and innocently enjoyed. Under a proper environment the moral dangers are in fact less."

So far as instruction is concerned, the University attempts to obviate the evil of large classes by the division into sections, sometimes for all the work of the course, sometimes for recitations only. It is true that some of these sections are, necessarily, in charge of the less experienced instructors. Yet the number of inexperienced instructors and their lack of experience are sometimes exaggerated. As a matter of fact the average of years of teaching of instructors in the lower division of the University of California is considerably higher than that of instructors in the oldest of the junior colleges. Moreover, in the University, a lower-division course is always conducted in part at least, by the older members of the department. In every case it is planned by them and remains under their control, the subject of frequent criticism and discussion in department meetings. Thus the accumulated experience of the department is continually at the service of all its members, and, not infrequently, the tradition of a great teacher is felt in all its work.

The University gives special attention not only to the instruction of lower-division students but to their welfare outside the class-room as well. It maintains a corps of advisers, who come into close contact

[8] *School Review*, 21: 165.

[9] Report of the President of Harvard College 1913–14, pp. 8f.

with all Freshmen. It requires of all intrants a physical and a medical examination, and extends to all the privileges of the University Infirmary. It visits and officially approves boarding houses for University students. It holds fortnightly University meetings which are addressed by men of prominence, sometimes within but more often from without the academic world. Under its guidance the fraternities are coming more and more to be influences for good, in conduct and in scholarship. Even "student activities" are not an unmixed evil; they teach co-operation, prepare for citizenship, and lead to valuable friendships.

The high-school principal will naturally keep such matters as these in mind in advising his students. The choice of junior college or university will be determined by these considerations, by the character of the student, and in large measure also by the department of study which he desires to enter. It is hoped that the following pages will be of use in the last-named connection.

PART II. DEPARTMENT RECOMMENDATIONS

AGRICULTURE

Agricultural courses given in junior colleges should be planned primarily as vocational or culminative courses for students who cannot go to a college or university. They should be of a grade comparable with the agricultural courses in the University and worthy of recognition and crediting by the University as electives in agriculture. They should be at the same time sufficiently practical and applicable to local conditions to fit the needs of a prospective farmer. They might well be arranged in various groups suiting the needs of different classes of students and preparing for different farm enterprises, as for example: (1) A course in animal husbandry, including study of types and breeds of farm animals, their care and management, conformation and soundness, feeds and feeding, etc.; (2) a course in horticulture, including study of pomology, olericulture, etc. Other similar courses will suggest themselves.

The agricultural course of the junior colleges should include also courses in the natural sciences and humanities acceptable in place of similar work given in the University, and required or advised for agricultural students. Such courses are those in botany (2 and 3), chemistry, foreign languages (preferably French and German), English, mathematics, history, economics, zoology, physics, geology, physiography, mineralogy, drawing (freehand and instrumental), bacteriology.

On the other hand, it is highly undesirable that the junior colleges should undertake such courses as Agricultural Chemistry 1 and 2, Genetics 1, Landscape Gardening 1, and Soil Technology 1. These courses are technical courses, given as a necessary preliminary in the training of agricultural experts. If given by the junior colleges, the College of Agriculture could not accept them as substitutes for the University courses. In response, however, to numerous inquiries, estimates of cost of equipment on a university basis are given below.

The student from the Junior College would have to spend three years in the University in order to cover the work required for a degree in agriculture.

Equipment

Agricultural Chemistry

The amount of equipment of certain classes will of course depend on whether or not the institution already has a chemical laboratory which is free for use at certain hours. The ordinary undergraduate chemical laboratory may be used for teaching agricultural chemistry, so that with

well-equipped laboratories no special expense for benches, hoods, etc., need be incurred. If, however, the institution merely possesses bare rooms with floor-space, the cost of equipment and maintenance will be somewhat as follows, for a teaching unit of thirty students:

Benches, hoods, plumbing, etc.	$1,000.00
Analytical balances (6)	180.00
Steam baths, ovens, and special equipment	150.00
Glassware, chemicals, etc. (estimated cost per student, $20)	600.00

Making a total in the neighborhood of $1900.00 or $2000.00 for installation and special equipment. The cost of maintenance for glassware, chemicals, etc., will probably be in the neighborhood of $8.00 per student per term, or $240.00. This of course does not include the cost of heating buildings, water, gas, electricity, etc.

Soils

The following figures are based on the assumption that four students would represent a unit in the laboratory work. Each student would require about $16.75 worth of laboratory apparatus for the equipment of his own desk. The four students who would work in a group would require general equipment totaling about $106.50. This general equipment covers the relatively cheap balances that we are using, drying ovens, etc., and apparatus that can be assigned to one student for a period and then assigned to another at a different period. In addition to this, there would undoubtedly be needed one accurate balance costing about $50.00 and one heavy scale or balance, costing about $25.00, the latter to be used in weighing bulk soils. A further cost would be necessitated for such things as soil sieves, soil containers, waste cans, etc. Including the balance mentioned above, the general equipment would total about $200.00. About $100.00 worth of this general equipment would be available for only four students at each laboratory period but could be used by students in other sections. The proper equipment of such a laboratory, for twenty students, would cost about $1000.00.

Plant Propagation

To accommodate a unit of twenty students the following equipment would be necessary:

One lath-house, approximately 16 by 24 feet, having raised benches at the sides and ends, with solid bed in the center, and with head-house attached, approximately 6 by 16 feet, which should provide working benches, bins for soil, sand, fertilizer, etc., and closets for tools and seeds respectively—such structures on good concrete foundations to cost, painted outside and inside, approximately	$600.00

A greenhouse of about the same size as the lath-house, above mentioned, together with the same kind of head-house, both heated with hot water, would be more serviceable than the lath-house in many sections of California, and would cost approximately $1,200.00

If a glass house were not necessary, because of climatic conditions, some glass-covered cold frames should be provided, in addition to the lath-house; these would cost approximately.... $100.00

Other equipment necessary would be as follows: Garden and greenhouse tools, such as hoes, rakes, spades, trowels, etc.....$150.00 to $200.00

Seeds, bulbs and nursery stock $200.00

Miscellaneous supplies $150.00

All of the above data is submitted on the assumption that land is available upon which these structures may be erected, and sufficient ground available for nursery and garden work. No estimate is given for labor, which might refer to the cost of plowing and preparing nursery and garden areas.

In conclusion, therefore, it may be stated that equipment for the teaching of plant propagation may be very satisfactorily provided for twenty students for the sum of $1250.00 or $2450.00, according to whether a greenhouse or lath-house is built. It is quite possible, of course, that the lath-house, head-house, greenhouse and cold frames might accommodate more than twenty students providing they are handled in sections.

Genetics

For twenty students a well-lighted laboratory of 2400 square feet should be provided. There should be about 7½ square feet of table space for each student, together with lockers, blackboard, a small refrigerator, electrically heated incubator case, wooden trays, homeopathic vials, small weighing scales, herbarium shelves, presses, driers, mounting paper, etc. Also a good compound microscope with oil immersion lens, costing about $75.00. Probably the laboratory to accommodate twenty students could be furnished for about $500.00 and equipment would cost about $300.00. There should be an enclosed garden for experimental breeding, with a tool-house, and a small greenhouse exclusively for breeding experiments; also, if possible, a small animal-house or breeding-pens for guinea pigs, rabbits, poultry, etc. Assuming that the school is in possession of the land, the cost of construction, fencing and equipping need not exceed $1000.00.

Allowing $200.00 for books, charts, lantern slides and miscellaneous materials, the total outlay would be something like $2000.00.

ASTRONOMY

(A) Vocational or other purposes not directly related to university preparation.

For vocational purposes astronomical courses are not usually undertaken, except in connection with surveying work. For this purpose junior colleges might well undertake course 3 as listed in the University's ANNOUNCEMENT OF COURSES. This course contains elements of trigonometry, elements of astronomy, computing with especial reference to surveying, with emphasis on the solar attachment transit. Institutions which desire to undertake this course should confer directly with the department as to its proper organization. The necessary equipment, including books and instruments, would cost about $500.00. Other lower-division courses in the University, particularly course 1, are in general for cultural purposes only. Such courses might properly be undertaken by junior colleges on the basis of any of the more modern books on elementary and general astronomy. If practical work be offered, it would be well for the junior college to confer with the department. Courses corresponding to University courses 1 and 2A–2F might be undertaken.

(B) The satisfaction of prerequisites for specific university courses.

Lower-division astronomy courses in the University of California are prerequisite only for engineering and geography. For geography, courses 1 and 2A are prescribed, and for civil engineering course 3. All of these have been referred to above.

(C) Provision for general or substantial equivalents for university courses or subjects commonly taken in fulfillment of Junior Certificate or degree requirements.

Courses 1, 2A–2F and 3 are here to be mentioned again.

EQUIPMENT

Satisfactory library equipment for junior-college work could be secured for about $250.00, and might be maintained at a cost of from $25.00 to $50.00 per annum.

The laboratory apparatus necessary for courses 2A–2F, elementary practical work, should include a small equatorial, a small transit instrument, sextants, alt-azimuth instruments, chronometer, chronograph, and some minor accessories. All of these can be had at a cost of about $5000.00. The catalogues of Gaertner of Chicago, and Brashear of Pittsburgh are suggested for a description of instruments. Satisfactory instruments may be obtained from these firms at moderate cost. About $250.00 per annum should be available for maintenance and expenses.

The following text-books are suggested: Moulton, *Elements of Astronomy;* Young, *Elements of Astronomy.*

BOTANY

The training in botany for vocational and other purposes is practically the same as that required for admission to the more advanced University courses. Such training is outlined in the University's ANNOUNCEMENT OF COURSES, Botany 2 and 3. If such courses are undertaken by junior colleges they should be given from the college rather than from the high-school point of view. If so given they would fulfill the requirement in botany for the Junior Certificate.

Proper library facilities should include a series of recently issued text-books for college classes in botany, and also a series of botanical encyclopedias, floras, treatises on special phases of botany, etc. An initial outlay of $1000.00 would provide a fairly satisfactory library equipment, but one-half of this amount would suffice in case additional expenditures of $100.00 per year could be provided for. Even though the botanical library were well equipped at the beginning, it would be necessary to allow $50.00 to $100.00 for its annual maintenance in order to keep it abreast of the subject.

The initial cost of equipment necessary for a class in botany of twenty-five students should be approximately as follows:

25 dissecting microscopes	$225.00
25 dissecting sets	40.00
25 compound microscopes	750.00
1 set demonstration charts	150.00
Lantern slides	150.00
Preparations in liquid and microscopic preparations	100.00
Reagents, glassware, hardware, etc.	500.00
Apparatus for plant physiology	500.00
Propagating house for student's use	750.00
Total	$3,165.00

In preparing the above figures an almost ideal equipment for a class of twenty-five students has been kept in mind. In case rigid economy is necessary a reduction could be effected in the item for apparatus for plant physiology. By the use of inexpensive apparatus and by some modifications in the course, a resourceful instructor might reduce this allotment to $200.00. By economy the estimate for reagents, etc., also might be somewhat reduced. Further reduction could be made by the omission of a house for plant-propagation but this is undesirable since students would then be obliged to do a certain amount of this work in the laboratory. The expense for a class of fifty students in two sections would obviously be but little more than the expense as above indicated for one-half the number.

In preparing the above estimate it is assumed that an allowance will be made each year for the purchase and collection of living material from the nurserymen or gardeners. This would amount to anything from $100.00 up, which expense would be obviated in case the school is provided with a propagating house and garden under the control of a trained gardener.

CHEMISTRY

Aside from the first course in matriculation chemistry, the courses in chemistry which may be undertaken by the junior colleges may be divided into two classes: *First,* those which may be accepted for university credit, but which do not prepare the student for advanced university courses in chemistry. A thorough course in any of the various branches of chemistry may be included in this group. *Second,* courses which not only can be accepted for university credit, but also prepare the student directly for advanced university courses. The University course, Chemistry 1A–1B, includes lectures twice a week, quiz section once a week, and laboratory work, two two-hour periods a week throughout the year. The lectures and quiz work deal with systematic inorganic chemistry and cover the same ground as such text-books as those of Alexander Smith and of Cady, with special reference to the fundamental laws and principles underlying this subject. The laboratory work includes experiments in the use of balances and burettes, illustrating the laws of stochiometry and the meaning of such terms as molecular weight, equivalent weight, concentration, molal solutions and normal solutions. The chemistry of aqueous solutions is given special consideration, and ionization, strong and weak electrolytes, the qualitative laws of equilibrium, hydrolysis and solubility are treated in detail. These fundamental ideas are then applied to the problems of qualitative analysis, and the student devotes the remainder of the year to the systematic study of the qualitative separation of elements and radicals.

While the Department of Chemistry does not necessarily expect any institution to follow the same method or the same order as is adopted in this course, no student who has not received thorough instruction in the work here outlined can be admitted to more advanced courses in chemistry. In case of doubt as to a student's fitness to enter advanced courses he may be given an oral or written examination by the department.

The courses in chemistry which follow Chemistry 1A–1B are courses in quantitative analysis and inorganic chemistry. If such courses should be given in the junior colleges their suitability for university credit or as preparation for the further advanced courses in chemistry may be determined as in the cases already discussed.

CIVIL ENGINEERING

Surveying

Junior colleges are advised to undertake Civil Engineering instruction only in course Civil Engineering 1ABCD, the Principles of Plane Surveying. Even with respect to this course a reservation is stated in the closing paragraphs of this announcement.

Preparation for surveying course Civil Engineering 1ABCD should comprise thorough knowledge of plane trigonometry, matriculation 12*a*"; the use of logarithms; and mechanical drafting, matriculation 17.

A surveying course should include both field and office practice; it should provide class-room drill in the principles of the subject. Many problems should be assigned. The subject matter is that included, for example, in Volume I of Breed & Hosmer's *Principles and Practices of Surveying*, and in chapters 4, 5 and 8 of the same text, Volume II. This text is here mentioned because at present it is the one prescribed at the University. A junior college might prefer to treat the similar subjects in another text included among those mentioned below.

Surveying instructors in junior colleges should be engineering graduates from technical schools of recognized standing, or otherwise should be teachers who have acquired a similar training.

The time allotted to the course Civil Engineering 1ABCD should be not less than two hours per week of lectures and recitations, plus a three-hour period per week comprising field work and office practice. The total length of the course should be, throughout one year, normally two semesters of sixteen weeks each.

The instrumental equipment available for student use must be generous, comprising transits, levels, alidades, and minor apparatus, representing different instrument makers. The minimum cost of a useful equipment cannot be less than $2500.

The junior college library should include the following books on surveying: Breed & Hosmer, *Principles and Practice of Surveying*; Pence & Ketchum, *Surveying Manual*; Raymond, *Plane Surveying*; Tracy, *Plane Surveying*; Johnson, *Theory and Practice of Surveying*; together with logarithmic, latitude and departure, and other mensuration tables. There should be available for student use and instruction at least some forms of computing instruments, particularly slide rules. Special blank forms should be prepared for the taking of field notes and their reduction. The student should be required to use regulation transit and level books, etc. There should also be provided standard texts on algebra, geometry and plane trigonometry. The yearly cost of maintaining and adding to such a library is small.

The surveying courses offered by junior colleges should be primarily for students who do not propose later to enter the colleges of engineering in the University of California, or other similar engineering schools. Engineering students should be advised to defer work in surveying and other technical subjects. They will profit more by using their time in the junior college for wider preparation in languages, history, economics, natural science and mathematics. Some of these subjects would be those prescribed in the engineering colleges in the freshman and sophomore years. Others not prescribed could be offered as electives to be honored in any year of the four- or five-year University courses. Thus a junior college graduate who enters the University with advanced standing or electives in subjects like language and mathematics may be graduated sooner or may have the advantage of using his residence for additional engineering subjects.

Ordinarily a junior college student must spend at least three years in the University to complete the work required for the B.S. degree in the colleges of engineering.

DRAWING

Mechanical and Engineering Drawing

(A) Subjects for which Matriculation Credit is given.

Geometrical Drawing, equivalent to University course C–D, for which matriculation credit in subject 17 is given; and which subject is fully described in a circular issued by the Department.

(B) Subjects for which University Credit may be given.

Descriptive Geometry, equivalent to University courses 2A and 2B. A drawing course covering in 2A the fundamental problems on point, line and plane; sections; developments; construction of solids; and intersections; and in 2B applications to contours and warped surfaces; axonometry; shadows, shades and perspective. The object of the course is two-fold: to give the pupil a working knowledge of the principles of geometrical construction; and to enable him to do neat and accurate work. The complete course constitutes about 50 drawings. These should be made on durable paper about 12 by 17 inches, with half-inch margin. The drawings should be inked, using colors; the given elements in black; the construction lines in red or other suitable colors; the results in blue. Many drawings should be tinted to show more clearly areas and solids; this tinting is also a great help to the pupil in aiding him to visualize the objects represented. The time required by such a course is nine hours of actual work per week for one year, or four and one-

half hours (or five periods) per week for two years, which latter arrangement offers many advantages. This subject is required at the University as a prerequisite for many Junior courses in engineering and architecture and is give 6 units of credit.

Lettering, equivalent to University course 9.

A course covering the construction, shapes, proportions of spacings of the standard styles such as straight and slanting Gothic, Roman, Italic, Old English and unconventional; the completion and construction of titles. The course should consist of about seven drawings and require four actual hours per week for one term: 1 unit credit.

(C) Vocational Courses.

For these no University credit can be given unless it be under free electives, as the courses given at the University are approached from a mathematical and scientific standpoint in upper division work.

1. Shop drawing.
2. Machine drawing.
3. Structural drawing.
4. Architectural drawing.
5. Topographical drawing.
6. Sign painting.

The various subjects should be taken in connection with shop or field work. Sketches should be made from actual objects or the object constructed from the drawings. Scale drawings of objects, machine parts, and assembled parts should be carefully made, detailed and dimensioned. These should be accompanied by a full explanation of the problems of theory, mechanics, physics, and practical considerations governing each problem. The outlines of these courses can better be obtained from the trade and technical schools than from the University.

All the above classes might be given in a room 20 by 35 feet. This would accommodate a class of 30 at about twenty-two and one-half square feet per student, including aisles. Its equipment of tables, stools, blackboards, lockers, models, etc., would cost about $1000. The necessary library of about 75 volumes will cost about $150, and the annual allowance for same, including magazines, should be about $30.

Freehand Drawing and Graphic Art

It seems highly desirable that efficiency in freehand drawing should be acquired before students are allowed to devote themselves to any so-called "art studies." It will be found very frequently that owing to many causes a fundamental knowledge in freehand drawing is lacking, and therefore a thorough course in that subject should constitute the chief

instruction in the field of freehand drawing. This training is essential to all applied sciences leading to the development of clear observation, clear deduction and the ability for expression through sketch, freehand diagram or scientific drawing. As a means of expression it should be cultivated as carefully as a language is cultivated. The freehand drawing required for Matriculation Subject 16, and which is equivalent to Drawing A–B given in the University, is more fully described in a circular issued by the Department.

Closely following elementary freehand drawing, a course for the study of light and shades from casts in charcoal, wash, and pen and ink should be given. After a proficiency in freehand drawing has been acquired instruction should be started in the principles of decorative design, considerable time being given to the study of the many principles that have a controlling influence in the making and understanding of any work of art. Practical problems in black and white of a simple nature should accompany these lessons. Along with design, color theory should be studied in its many scientific and artistic aspects, together with practical problems in the making of charts and simple paintings.

Picture making, painting in oils, should be *entirely omitted* from the curriculum of a junior college. The work done should be fundamental and no attempt at professionalism of any sort should be made. The attention of the junior colleges is called to the pamphlet on freehand drawing issued by the University of California, which will serve as a guide in this most important subject.

The physical requirements should include a large room, say thirty-five by sixty feet, with good side light, preferably from the north, equipped with drawing tables.

ECONOMICS

Junior colleges may properly give courses in Elementary Economics, Commercial Geography, Accounting, Economic, Commercial, or Industrial History. If satisfactorily given, and if covering a fair equivalent of the work at the University, this instruction will probably be accepted as equivalent to Lower-Division work in the University of California. Attention is called to the fact that the course in Elementary Economics is a full year's course.

ENGLISH

The English course in the junior college is different from similar courses in certain other subjects in that its aim is attainment in expression and liberal acquaintance with standard literature, rather than a specific amount of knowledge. Intended primarily for those who will not go further with their scholastic training, it must yet provide for those who

would enter advanced classes at a university. The English studies should therefore be equivalents of corresponding studies in the lower division of the University, rather than their exact duplicates.

The aim of such a course would be: (*a*) to equip the student with ability to express himself appropriately in speech or writing, together with a fundamental understanding of the forms of discourse as to organization of thought and as to style; (*b*) to give a broad acquaintance with the greater masterpieces in English, as well as an historical view of English literature.

A complete junior-college course in English may be made up from the alternatives under matriculation subjects 14*a* and 14*b*, according to the new plan. These alternative courses may be distributed at convenience over the four years comprising the advanced high-school years and the two college years. Any program of studies, however, should include: (*a*) one full-year course in composition, oral and written, taken in the college period (e.g., $14a^2$, or $14b^2$, or $14b^4$–*e* if given as a full-year course); (*b*) and one full–year course in the history of English literature (e.g., $14b^3$) taken not earlier than the senior high-school year.

GEOGRAPHY

Courses

The only course recommended is the equivalent of Geography 1A offered at Berkeley. This is primarily a course on the evolution of topography and the relations of land forms to man's work. The course should include some discussion of the aims and methods of modern geography and the past and present problems of the science.

Tarr and Martin's *College Physiography* (Macmillan, 1914) is recommended as a text. Part III, the Atmosphere, should be treated very briefly or omitted entirely in a half-year course.

Teacher

Such a course should not be given in junior colleges unless the teacher has *a thorough training which includes field work*. No recommendation is made for the teaching of meteorology in junior colleges largely because of the great difficulty of obtaining a teacher thoroughly trained in observational methods with modern apparatus.

Laboratory Equipment

Aside from a room properly equipped with tables suitable for map work, the special equipment need not be large. The work should be given with a constant emphasis on the idea that the field is the only real

laboratory. In accordance with this idea lantern slides should be used freely as a substitute for the kinds of field work not found in the immediate vicinity. A set of four or five hundred slides should be obtained, and many of them should represent the physiography of the various provinces of California. A set of good physical maps of the continents and some relief models showing evolution of topography (such as the Harvard Geographical models, published by Ginn & Company) are also needed. A well-chosen set of topographic maps is, of course, essential.

Library

As large a set as possible of those publications of the U. S. Geological Survey which are largely physiographic should be obtained and kept up to date. Aside from these, fifty to one hundred of the best reference books in physiography and physiographic geology should be obtained as the nucleus of a library. Three or four of the leading geographical journals should be kept on file, and to these might well be added the University of California Publications in Geography.

Not including fitting up a room with tables for map work, the laboratory equipment for starting might be kept down to $200 to $250, and the library, aside from the government publications, many of which are free, ought not to exceed $200; that is, a satisfactory equipment will initially cost from $400 to $500.

GERMAN

The work in German to be done in junior colleges may be divided into two classes:

I. German for students who have had no previous training in this subject. For such students courses should be provided parallel in scope to those given in the Lower Division in the University. When, however, the junior college adheres to the shorter period of recitation, a somewhat different distribution of work from that in the University would seem advisable, viz.:

(1) For fifth year students: Elementary German (corresponding to courses AB and to the first half of course CD in the University), five hours a week, approximately equivalent to two years' work in German in high schools;

(2) For sixth year students: Intermediate German (corresponding to the second half of course CD and to course EF in the University), five hours a week, approximately equivalent to two years' work in German in high schools.

German should be used as much as possible in the classroom from the beginning.

II. German for students who have had three or four years of German in high schools:

Following the practice in the University the Department of German would recommend that no courses be given in the History of German Literature, but that reading courses only be provided, viz.:

(1) For fifth year students: A reading course in Nineteenth Century Literature: selected works of such writers as Grillparzer, Heine, Freytag, Keller, C. F. Meyer, Wildenbruch, Hauptmann, Sudermann;

(2) For sixth year students: A reading course in Eighteenth Century Literature: the dramatic works of Lessing, Goethe, Schiller; exclusive, however, of such works as may be profitably studied only at a more advanced stage, such as *Torquato Tasso* and *Faust*. Selections from the prose writings of Goethe and Schiller are also recommended.

All works in this group should receive due interpretation from the literary point of view. In both years a systematic study of more advanced grammar should be pursued, and considerable attention be given to written work.

A list of the most important books for a working library may be had on application to the Department of German. Proper attention should be given to periodicals, and annual appropriations be allowed for a systematic growth of the library.

GREEK

In localities where Greek is not taught in the high school it is desirable that the junior college should offer matriculation subjects 8 and 9, or the University courses Greek A–B, C–D. In localities where Greek is taught in the high school it is desirable that the junior college should undertake Greek 1 and 2 as outlined in the University Announcement.

HISTORY

The objective to hold in mind in planning junior-college courses in history is the giving of instruction upon a college basis. The text-book method, which prevails in high-school teaching, must be abandoned by the junior college if it is to fit its students to undertake advanced undergraduate work in the college or the university. The junior college, like the first two years of the college course, should bring the history student to substitute for the text-book and the recitation upon a set lesson the reading and comparison of many works. Not only is the student to be

made familiar with standard works, but he is to note differences of opinion and to become familiar with controversies in regard to the interpretation of the past. This change in the treatment of history, which ordinarily comes as the student passes from the school to the college, belongs to the transition from the fourth to the fifth year of the high school and is of vital importance. Without it the work of the junior college fails to fulfill its function from the college point of view and becomes so much more high-school work.

The ability of a given school to provide instruction in history of a grade equivalent to that of the freshman and sophomore years in the university will depend upon three factors, namely, the adaptability to college methods of instruction of the subjects in its course of study, the adequacy of its equipment for its work, and the preparation of its teachers for the more advanced type of instruction.

The subjects which are recommended by the History Department of the University of California as especially suited to the course of study in the junior college are Western American History, History of the Nineteenth Century and advanced English History. General History in the fifth year of the high school tends to become a mere repetition in briefer form of the work in Ancient, Medieval, and Modern History usually offered in the first and second years. Little is to be gained by the repetition of these courses, even from a different point of view, by the same teachers. Furthermore, the field is too extensive to permit a high school or city library to provide proper equipment in books for the whole field of general history. Commercial history is not recommended as a junior-college subject. Text-books are inadequate, and suitable equipment for such a course at the present time can hardly be provided. Moreover, the giving of a separate course in commercial history in the absence of a previous course in elementary economics is inadvisable. The teaching of the recommended fields of history offers a considerable place for economic history, and the so-called commercial history is better handled as a part of these courses than by itself. California history is unsuitable for junior colleges on account of the lack of available material of sufficiently advanced grade. On the other hand, there does exist a body of material for use in grade schools where a large part of the children of California may be reached.

The three courses named above are especially recommended to junior colleges for the following reasons:

Western American History should be studied by graduates of Western high schools both from the point of view of the Trans-Mississippi West as a geographical region with a history of its own and from that of the Westward Movement as an historical process. National history has been so largely written from the Eastern point of view that the essential

character of Western History has been neglected. In California there is special need that Western History should be studied on account of the importance of the Spanish occupation and settlement, a movement which has been altogether neglected, but which forms the background of all subsequent developments. Western History combines the history of the northward movement from Mexico, and the southward movements from Canada and Russia with the westward movement across the American Continent. Thus it calls for acquaintance with literature not used in ordinary courses of instruction.

The history of the Nineteenth Century is likely to be slurred over in the work of the second year in high school because it comes at the end of the school year and because of the intrinsic difference in its character from former periods. There is a certain degree of surety with regard to the perspective in which they are observed, but there is no such surety with regard to Nineteenth-Century History, of which the issues change and the perspective is altered with the passing of events. It is very difficult, therefore, to handle Nineteenth-Century History, especially in its later decades, from a text-book. In teaching it dependence must be placed on the large literature of current events which is easily accessible in high-school and city libraries. Another point of difference is the necessity that much more time should be given to social and economic movements than is possible in the second-year course.

English history is not universally given in high schools and is usually a third-year elective. It is an admirable study for the fifth year. In this year more attention can be given to those phases of the subject which have especial importance to the American student. The history of English institutions, as a background for the study of American institutions, should constitute the actual basis of the course. The equipment for work in this field is comparatively easy to provide, as English history is usually well represented in high-chool and city libraries. A course in institutional history affords opportunity for a kind of work different from any other likely to be pursued in the junior college.

A fair amount of library equipment is essential to success of junior college work in history. Unless a good number of books are made available, students will be unable to do the grade of work necessary to maintain the junior college standard. The number of books required will of necessity vary with each course and with the judgment of each instructor. The History Department of the University of California has provided a limited list of books suitable for each of the three junior-college subjects which it recommends. These lists may be had upon application. The purchase of all the works represented upon them would call for an expenditure, in Western American History, of about $75 ($50 additional if original narratives and publications of societies are in-

cluded); in the History of the Nineteenth Century of about $105; in Advanced English History of about $65. When the class is a good-sized one and the instructor wishes it to make regular use of certain books, allowance should be made for providing duplicate copies. One junior college reports that for a class of about thirty in Nineteenth-Century History there are ten or more copies of three of the books used and from two to a half-dozen copies of some fifteen others. In some places teachers have had considerable assistance from town librarians who have been ready to procure and to make accessible to junior-college classes a good part of the material required.

Suitable preparation to equip teachers for work in junior colleges may be secured by fulfillment of the requirements for the master's degree in addition to those already met by students who are recommended in the University of California for high-school teacher's certificates. Experience has shown that it is almost impossible for a student to obtain a teacher's certificate in history and a master's degree in one year of graduate work. Two years of graduate work and the taking of a master's degree provides adequate training. The longer preparation and the fact of having accomplished a real piece of historical investigation fittingly mark the distinction in preparation between the junior-college teacher and the high-school teacher.

HOME ECONOMICS

The University of California offers at present two distinct courses of study under the general head of home economics; one in domestic art and the other in domestic science.

Students who wish to make domestic art their major subject must have completed the high-school courses in advanced sewing and dressmaking or their equivalents. These courses are not offered in the fall or spring sessions of the University; they may, however, be taken during the summer session. Lower division work at the University should include Drawing 1, 6 and 7, Economics 1A–1B, Botany 1A–1B. Courses strongly recommended for election are History 1A–1B, Architecture 5, Political Science 1A–1B. Students who intend to specialize in house furnishing should take in addition Drawing CD. Such a course of study precedes training in the upper division for specialization in costume design or house furnishing.

Students who wish to make nutrition (domestic science) their major subject must have completed high-school cooking as indicated in matriculation subject 18*d*. Courses in elementary and advanced cooking are not offered in the fall or spring sessions of the University; they may, how-

ever, be taken during the summer session. The lower division requirements are Chemistry 1A–1B, Chemistry 8A–8B, Economics 1A–1B. Political Science 1A–1B is strongly recommended for election. For students who intend to become candidates for the High School Teachers' Certificate with nutrition (domestic science) as a major subject, Chemistry 5 is also required. Such a course of study precedes training in the upper division for specialization in food preparation or dietetics.

In consultation with a member of the Study-lists Committee on Home Economics, students may combine the lower-division work for the two courses. Such a combination is rarely practical, however, on account of the strong emphasis on lower-division drawing on the one hand and lower-division chemistry on the other.

Suggested outlines for lower division work including prerequisites for advanced work in domestic art, arranged according to Plan A or Plan B of requirements for the junior certificate in the College of Letters and Science are as follows. (The designations of subjects here given, e.g., English 1B, refer to the annual ANNOUNCEMENT OF COURSES.)

DOMESTIC ART

LOWER DIVISION WORK

PLAN A

First Year

1st Half-year		*2nd Half-year*	
Botany 1A	3	Botany 1B	3
Logic or Mathematics	3	Logic or Mathematics	3
Foreign Language	5	Foreign Language	5
Physical Education	½	Physical Education	½
Hygiene	2	History or Political Science	3
Graphic Art 6	2	Drawing CD	2
Graphic Art 7	2		
	17½		16½

Second Year

1st Half-year		*2nd Half-year*	
Economics 1A	3	Economics 1B	3
Chemistry 1A	5	Chemistry 1B	5
Graphic Art 1	1	Graphic Art 1	1
History or Political Science	3	*Latin	3
*Latin	3	Physical Education	½
Physical Education	½	Electives	4
	15½		16½

Subjects A and B, required without unit credit.

* Probably completed in high school.

PLAN B

First Year

1st Half-year		*2nd Half-year*	
English 1A	3	English 1B	3
Mathematics C	2	Mathematics B	2
Physical Education	½	Physical Education	½
Hygiene	2	History or Political Science	3
Graphic Art 6	2	Foreign Language	5
Graphic Art 7	2	Botany 1B	3
Botany 1A	3		16½
Elective	1		
	15½		

Second Year

1st Half-year		*2nd Half-year*	
Mathematics A	2	Economics 1B	3
Economics 1A	3	Graphic Art 1	1
Graphic Art 1	1	Chemistry 1B	5
Chemistry 1A	5	Physical Education	½
Physical Education	½	Electives	7
Electives	5		16½
	16½		

Subjects A and B, required without unit credit.

Suggested outlines for lower division work including prerequisites for major work in nutrition (domestic science), arranged according to Plan A or Plan B of requirements for the junior certificate in the College of Letters and Science are as follows. (The designations of subjects here given, e.g., English 1B, refer to the annual ANNOUNCEMENT OF COURSES.)

DOMESTIC SCIENCE

LOWER DIVISION WORK

PLAN A

First Year

1st Half-year		*2nd Half-year*	
Mathematics or Logic	3	Mathematics or Logic	3
Latin	3	Latin	3
Chemistry 1A	5	Chemistry 1B	5
Political Science or History	3	Political Science or History	3
Hygiene	2	Physical Education	½
Physical Education	½	Electives	2
	16½		16½

Second Year

1st Half-year		*2nd Half-year*	
Chemistry 8A	2	Chemistry 8B	2
*Chemistry 5	3	Economics 1A	3
Economics 1A	3	Foreign Language	5
Foreign Language	5	Physical Education	½
Physical Education	½	Electives	6
Electives	3		
	16½		16½

Subjects A and B, required without unit credit.

PLAN B

First Year

1st Half-year		*2nd Half-year*	
English 1A	3	English 1B	3
Mathematics C	2	Mathematics A	2
Chemistry 1A	5	Chemistry 1B	5
Political Science 1A	3	Political Science 1B	3
Physical Education	½	Physical Education	½
Hygiene 1	2	Electives	3
	15½		16½

Second Year

1st Half-year		*2nd Half-year*	
Mathematics B	2	Economics 1B	3
Economics 1A	3	Chemistry 8B	2
Foreign Language	5	Foreign Language	5
Chemistry 8A	2	Physical Education	½
*Chemistry 5	3	Electives	6
Physical Education	½		
Elective	1		16½
	16½		

Subjects A and B, required without unit credit.

The foregoing statements and suggestions affect those students who expect to complete the work for the bachelor's degree at the University.

For those students who will not continue academic work after graduation from the junior colleges, the Study-lists Committee on Home Economics makes the following suggestions:

That there be introduced in the junior colleges certain technical courses in food, clothing, shelter and management, which, closely con-

* If High School Teacher's Certificate is desired.

nected with the courses in chemistry, drawing and economics, may serve to make clear the practical application of these fundamental subjects.

Since such courses are not offered in lower-division work at the University, the University reserves the right to give or to withhold credit for them, to those students who present themselves as candidates for the degree.

LATIN

Junior colleges may wisely parallel Latin 1, 2, 3, 5, and 10 as described in the University ANNOUNCEMENT.

The approximate cost of maps and books of reference would be $100.

The department is ready to give any specific advice that may be asked for.

MATHEMATICS

The department recommends the following courses, each for one half-year—the prerequisite being in general four years of high-school mathematics, viz. matriculation subjects 2, 3, 4*a*, 4*b*, 12*a*².

1. Plane Analytical Geometry.
2. College Algebra.
3. Differential Calculus.
4. Integral Calculus. (or)
5. Introduction to Projective Geometry.

Courses 1, 2, 3, and 4 are equivalent to the mathematics of the first two years in the engineering colleges at Berkeley.

The normal prerequisite for upper division courses in mathematics at Berkeley includes Courses 1, 2, 3, and 5, but Course 4 would be an entirely satisfactory alternative for Course 5.

The department is of the opinion that the mathematical requirements for the Junior Certificate would be best satisfied by the completion of the matriculation subjects referred to in the first paragraph, viz., two years of Algebra (3, 4*a*¹, 4*a*²), Plane Geometry (2), Solid Geometry (4*b*), Plane Trigonometry (12*a*²). With regard to these subjects, unless the school is so large as to require a division of the classes into sections, it is not desirable that the subjects should be duplicated in the junior college.

NOTE.—The department is willing to endorse the courses in General Analysis and in Elements of Analysis now offered for students who have had but two years of high-school mathematics, and will accept those courses as equivalent to University courses 1A–1B, but is unwilling to recommend the introduction of those courses into junior colleges in general.

With regard to equipment, an initial expenditure of two hundred dollars and an annual budget of twenty-five dollars should provide the absolutely necessary books. The department will gladly advise with junior-college teachers with regard to the purchase of books. A small collection of geometrical models would be of great value. These models are very expensive, however, and a very small number would cost several hundred dollars.

MINERALOGY

Instruction

Teaching should be done only by one who has made a special study of mineralogy in a college or university where good collections exist. The graduate student who has only taken an elementary course in the subject in his college cannot teach mineralogy properly. It should be required of a teacher that he has the endorsement of a professor of mineralogy.

Equipment

(*a*) A collection of good specimens, well labeled and arranged systematically for inspection and reference. It should include at least three hundred different mineral species with all of the more common minerals represented. Such a collection may cost approximately $500.

(*b*) Material for the practical determination of minerals. This may be purchased by the pound and would cost from $100.00 to $200.00 to supply a class of twenty.

(*c*) A collection of models to illustrate crystal forms can be purchased for $75.00.

(*d*) Laboratory.—A well-lighted and ventilated room equipped with tables, gas, apparatus and chemical reagents for the determination of minerals. The cost of equipping such a laboratory depends upon the size of the class and can hardly be estimated. The annual cost of maintaining it would approximate $5.00 per student. This may be met by a laboratory fee. It would require such apparatus and reagents as listed in Brush & Penfield's *Determinative Mineralogy.*

(*e*) A small library of mineralogical and crystallographic books is desirable for reference. Such books as Dana, *System of Mineralogy* with Appendices; Dana, *Textbook of Mineralogy;* Phillip, *Mineralogy;* Brush & Penfield, *Determinative Mineralogy and Blowpipe Analysis;* Eakle, *Tables for the Determination of Minerals,* and a few books on gem minerals, would be sufficient. Cost, $50.00.

COURSES

At least six hours per week for a year should be devoted to laboratory work in the practical determination of minerals, with and without the blowpipe. This amount of work will be accepted as the equivalent of the lower-division courses in mineralogy in this University. The laboratory course may be supplemented by lectures and conferences on minerals.

No course will be accepted as the equivalent of any upper-division course in mineralogy in this University.

PHILOSOPHY

Junior colleges may desirably undertake to give instruction in deductive logic and in elementary psychology, parallel with University courses in Philosophy 1A and 2A. It is not desirable for them to undertake at the present time any more advanced work.

PHYSICS

An advanced course in *general* physics (and not specialized treatment of limited subjects) constitutes the proper field for junior-college work in this subject.

Such a course should consist of three well-defined parts: the experimental lecture, the recitation, and the laboratory work, with about equal emphasis on the three parts. This course should stand squarely on the foundation furnished by a first course in the subject, proceeding either by extension of old topics or the addition of new ones. The first year's work in such a course should make free use of trigonometry; and the second year's work will demand familiarity with the calculus for the mathematical formulation of the subject. The scope of the lecture and recitation material is satisfactorily outlined in any one of the following text-books of physics:

Duff, *A Textbook of Physics.* 3d Edition, Blakiston.
Kimball, *College Physics.* Henry Holt.
Ganot, *Physics.* Atkinson, 18th Edition, Wm. Wood & Co.
Reed and Guthe, *College Physics.* Macmillan.
Spinney, *Textbook of Physics.* Macmillan.

The first year's work should treat the subjects of properties of matter, mechanics, and heat, with one lecture, one recitation, and one two-hour laboratory period per week throughout the year. The second year's course should take up the subjects of sound, light, electricity, and magnetism, devoting thereto one lecture, one recitation, and one three-hour laboratory period.

The cost of equipment, in addition to rooms already provided with suitable furniture and supplied with gas, water, and electricity, should be considered under three heads: (1) equipment of the shop or preparation room, (2) apparatus and reference books for students' use in the laboratory, and (3) demonstration apparatus for the instructor's use.

The shop equipment should consist of bench tools for both wood and metal, a lathe with accessories, a soldering outfit, and conveniences for glass-blowing. Its cost is estimated at from $300.00 to $500.00.

The lecture room and laboratory equipment for the first year's course is estimated at from $1000.00 to $1200.00 for a class of less than ten students.

A minimum equipment for the second year's course is estimated at from $1500.00 to $2000.00.

A reasonable allowance for maintenance of the shop and first course would be $150.00 annually, and for both courses $300.00.

In case only a partial course is offered, the laboratory work should be organized before an attempt is made to offer the experimental lecture, inasmuch as the satisfactory completion of the laboratory work would be of much greater assistance to a student transferring to another institution.

An instructor's specific preparation in the subject should be at least equivalent to that required for a major teacher's recommendation.

Copies of the laboratory manual, lecture outlines, and problem sets will be sent on application to the Secretary of the Department of Physics, Berkeley. A detailed list of apparatus required for the laboratory course is also available.

An outline of the topics which should be experimentally treated in the lectures of the first year's course follows. A similar outline for the second year's work will be prepared if called for.

Topics for the Experimental Lectures on Properties of Matter, Mechanics, and Heat

It will be noted that the number of phenomena listed which are not usually shown in a first course is small. The treatment here should be essentially quantitative. As the concepts involved in many cases are rather difficult, the phenomena may be shown in a variety of ways, the more familiar experiments being introductory.

Inertia: a general property of matter independent of the body's material, form, state, motion, or temperature. The uses of inertia as distinguished from the uses of weight. The measurement of inertia.

Three ways of measuring force. Weight a force. The proportionality

between mass and weight. Effect of a force, independent of the body's state of rest or motion, or the concurrent action of other forces. Composition and resolution of forces. Components of a force. Stress. Tension. Pressure.

Equality of action and reaction, in the case of mechanical, magnetic, electrical forces: between bodies in motion as well as bodies at rest.

Equilibrium of a particle. The tight-rope, wall-bracket, crane, inclined plane, and simple truss.

Equilibrium of a rigid body, forces in a plane. In addition to the above, the ladder problem; the weight of the various parts in all cases being taken into account.

Weight. Center of weight. Equilibrium.

Work: Machines, as contrivances securing convenience in location, direction, magnitude, or rate of motion. Principle of work applied to machines.

Laws of friction. Angle of repose.

Uniformly accelerated motion. The acceleration proportional to the force. With a constant force the acceleration is inversely proportional to the mass. Path of a projectile.

Conservation of momentum or impact, elastic and inelastic.

Centripetal and centrifugal forces. Surface of a rotating liquid. Simple harmonic motion. The pendulum, simple and compound. Center of oscillation, center of percussion.

The motion of the earth about its axis.

Precessional motion.

Pascal's law. The pressure exerted by a fluid at rest is perpendicular to any surface, at any point in the fluid it is the same in every direction, it is the same at all points on the same level. Pressure is proportional to the depth and to the density of the fluid, independent of the shape of the vessel.

Archimedes' principle.

Torricelli's experiment. Weight of air, pressure of air. Pumps. The siphon. The cistern barometer. The aneroid barometer.

Boyle's law, for pressures greater and less than one atmosphere.

Momentum of a fluid stream.

Torricelli's theorum. Vena contracta. Pressure gradient in pipes.

Efflux of gases.

Stream lines in fluids. Explaining the rotation of symmetrically pivoted bodies in either direction.

Cohesion of solids, properties depending on. Cohesion of liquids. The vacuum siphon.

Elasticity. Hooke's law. The elastic limit. The fatigue of elasticity. The elastic after-effect.

Viscosity of fluids, its change with temperature. Diffusion of liquids and gases. Change of volume on solution. Occlusion. Absorption of gases in liquids. Surface condensation. Osmotic pressure.

Surface tension, its change with substance and temperature, to be distinguished from superficial viscosity. Angle of contact. Formation of drops.

Expansion by heating of solids, of crystals, of rubber, of water, of gases. Force of contraction or expansion. Absolute method of determining the expansion of liquids.

Heat from chemical action, electric current, mechanical work on solids, liquids, gases.

Convection, liquids, gases.

Conduction of heat by metals, wood, water, crystals.

Specific heat of solids and liquids, depends on substance.

Fusion accompanied by change in volume. Heat of fusion. Effect of pressure on melting. Regelation. Retardation of freezing point. Freezing mixtures.

Supersaturated solutions.

Saturated vapor. Dew point. Vapor pressure, a function of the substance and the temperature.

Variation of boiling point with pressure, for high and low pressures. Geyser action.

The spheroidal state.

Sublimation.

The critical point.

Visible and invisible radiation. Reflection, refraction of radiation visible and invisible.

Radiating and absorbing power of various substances. Equality of radiating and absorbing powers. The law of cooling. Wien's displacement law.

Reference Books

Lodge, *Elementary Mechanics.* (Van Nostrand Co.)
Merrill, *Elementary Mechanics.* (American Book Co.)
Loney, *Elements of Statics and Dynamics.* (Cambridge University Press.)
Thompson, *Elementary Lessons in Electricity and Magnetism.* (Macmillan.)
Hadley, *Magnetism and Electricity.* (Macmillan.)
Poynting and Thomson, *Text-book of Physics in five numbers: Properties of Matter, Heat, Light, Sound, and Electricity and Magnetism.* (C. Griffin, London.)
Edser, *Light for Students.* (Macmillan.)

Edser, *Heat for Advanced Students.* (Macmillan.)
Maxwell, *Matter and Motion.* (Van Nostrand.)
Boys, *Soap Bubbles.* (E. S. Gorham, New York.)
Barus, *Laws of Gases.* (Scientific Memoirs, Harper.)
Lodge, *Pioneers of Science.* (Macmillan.)
Garnett, *Heroes of Science.* (E. and J. B. Young, New York.)
Cajori, *A History of Physics.* (Macmillan.)
Watson, *Text-book of Practical Physics.* (Longman, Green and Co.)
Miller, *Laboratory Physics.* (Ginn and Company.)
Kaye and Laby, *Tables.* (Longmans, Green and Co.)
Smithsonian Physical Tables.
Goodwin, *Precision of Measurements and Graphical Methods.* (McGraw Hill Book Co.)
Fleming, *Waves and Ripples.* (Society for Promoting Christian Knowledge.)
W. C. D. Whetham, *Recent Developments of Physical Science.* (P. Blackiston's Son and Co.)
Lucien Poincaré, *The New Physics.* (D. Appleton and Co.)
A. J. Berry, *The Atmosphere.* (Cambridge Manuals of Science and Literature.)
A. Wood, *The Physical Basis of Music.*
Cox, *Beyond the Atom.*

PHYSIOLOGY

Equipment

In the study of life phenomena the processes accessible to investigation are in the main physical and chemical. Only those schools which have well-equipped laboratories of physics and chemistry should attempt to give instruction in physiology in the fifth or sixth year, and no student should be encouraged to undertake the study of physiology in those years unless he is already grounded in elementary physics and chemistry.

A special university training in physiology is a necessary preparation on the part of the instructor who would give the courses indicated below. Normally such an instructor would have the equivalent of the Ph.D. degree with physiology as a major subject.

The courses suggested could be given effectively only by schools possessing a fairly adequate equipment in the way of laboratory and library. Much of the apparatus and material provided for physics and chemistry could be used in the experimental work in physiology, but in addition the physiological laboratory should possess a number of pieces of special apparatus. Among these would be included microscopes, kymographs, inductoriums, muscle levers, etc. The extent of such equipment, however,

should not be judged by the more complex and expensive outfit provided for instruction of medical students. Members of the Department of Physiology will gladly advise with schools desiring assistance in planning an equipment for this work.

Suggested Courses

1. *Experimental Biology.*—In view of the enormous variety of detail of structure in living organisms it is manifestly impossible for the junior-college student to make more than a beginning acquaintance with them, and it is much better to confine attention to those things that can have direct significance for him. Structures which have an evident meaning in function will be most advantageously studied in connection with their functions. A course of study suited to the needs of the beginner in biological science will be one which will unite the study of structure and function and so far as possible correlate the two. Not only is this the logically correct method but it is also pedagogically preferable, because it is the one which most surely awakens the interest of the student.

Such a course cannot be taught from a text-book. Use must be made in each locality of the material available in that particular region. Such use is well illustrated in the employment of the giant slug, *Ariolimax*, by Dr. Wulzen in the corresponding course in Introductory Biology in the Department of Physiology of the University of California. The attempt of Huxley and Martin a generation ago to outline a course of this kind has hardly been improved upon; but the emphasis was then laid too strongly on morphological detail and the physico-chemical side was practically ignored. The course herein recommended would take up a few type forms somewhat after the manner introduced by Huxley, but would also include much observation and experiment to illustrate the phenomena of life as interpreted by Loeb in his *Dynamics of Living Matter*. There should be well-planned experiments illustrating the reactions of organisms to light, temperature, gravitation and other forces. While there would be necessarily some attention given to the detailed functions of particular organs, the main stress would be laid upon the reactions of organisms rather than upon the functions of organs.

2. *Physiology, Human and Comparative.*—This, if properly taught, seems an appropriate subject for the fifth or sixth year of high school. The course outlined above under the heading Experimental Biology would deal somewhat more with the external aspect of physiology and with the wider effects of environment; this course would deal more particularly with the individual, with especial reference to the human. There is great need on the part of each individual for an understanding of himself,

including the forces and changes within his own body. The importance of such knowledge as a rational basis for hygenic and efficient living is obvious; but its claim to a prominent place in the curriculum goes much deeper. Some hint of this is seen in the number of names which have made their way into literature through medicine.

For the purpose of general culture a certain minimum training in comparative anatomy obtained through the somewhat careful dissection of one or more vertebrate types should be accompanied by good laboratory practice in the performance of a series of fundamental physiological experiments. It is at once apparent that this cannot be a text-book course, but something of its extent can be measured by Martin's *Human Body, Advanced Course* (Holt & Co.), and *Laboratory Directions in Introductory Physiology* (Syllabus 25, University of California Press). The work should be so planned as to re-enforce strongly the student's efforts in other lines. The chemical tests should demonstrate the usefulness of more chemistry, while the experiments on the special senses should form a rational basis for a later course in psychology. Emphasis must be laid upon the general character of the course; especially must it be understood that it is in no sense pre-medical.

POLITICAL SCIENCE

The most desirable course for a student in the junior college desiring to emphasize the subject of Government and Politics would be in the fourth year of the secondary course to take a full year's work in American Government, including State, Local and Municipal Government; in the fifth year the history of the last century of Europe and America, with emphasis on political and economic development; in the sixth year a comparative study of modern governments, corresponding as nearly as possible to Political Science 1A–1B, and including the Government and Politics of England, France, Germany, Switzerland, Austria-Hungary, and if possible Italy and Belgium. This course, if taken under advice from the Department of Political Science, may be accepted by the Department as the prerequisite to its own Upper Division work. Members of the Department will be glad to correspond and make suggestions relative to an outline of the work and text to be used.

ROMANIC LANGUAGES

The method used in the class-room need not essentially differ from that employed in advanced work in the University.

(1) French or Spanish should be used exclusively only by teachers who by birth, or thorough training and opportunity of study abroad,

speak those languages with fluency and correctness of idiom and pronunciation.

(2) Students should become imbued with the value of much reading in French or Spanish, outside of the class-room; books should be suggested, and not in connection with set tasks, but for the profitable results to be attained only through an acquaintance with the best writers of French and Spanish.

(3) Courses for fifth and sixth years should presuppose only students of unusual fitness for advanced study of the Romanic languages. To stimulate their interest, prizes could be offered for translations into faultless English of specific masterpieces of prose or verse. In Spanish especially, there is much to be accomplished in this regard.

(A) For purposes not directly related to University preparation (practical courses):

1. Study of the language, with ample practice in conversation; reading of scientific or commercial texts; study of grammar, syntax, idioms; learning selections of prose or verse by heart; much writing on the blackboard; a maximum of work on the part of the student and a minimum on the part of the teacher, that is, during the hour, the students should do almost all of the speaking or writing. This work may also be modified by assigning reading to be done outside of the class.

(B) As a preparation for further work in the University.

1. The language and literature of France and Spain should be studied in connection with the political history of those countries, whenever that is possible. Teachers will find it profitable to suggest to their students short histories in French or Spanish which present in brief form the salient features of successive epochs.

Cf. (In French) Lavisse: *La deuxième année d'histoire de France.* (Armand Colin) 1914.

(In Spanish) Moreno Espinosa: *Compendio de Historia de España.* 11th edit. Barcelona, 1909.

2. A careful study of individual authors or of a single period or literary movement (especially the nineteenth century), with lectures by the teacher supplementing assigned reading.

Among French authors to be studied, mention may be made of a few: Victor Hugo, Daudet, Erckman-Chatrian, Mérimée, Coppée, Augier, Dumas fils, Richepin, Herédia, etc. Novelists, poets, dramatists offer a wide range of choice.

Spanish: Larra, Mesonero Romanos, Ayala, Zorrilla Campoamor, Núñez de Arce, Duque de Rivas, Alarcón, Valdés, Galdós, Valera, Benavente and others.

3. Any course devoted especially to the study of the language will derive great benefit from memorizing on an extensive scale; the students should learn by heart whole pages of prose, or complete poems, and the teacher should then lay the greatest possible stress on accuracy and fluency of pronunciation. Resumés in Spanish or French of assigned reading should be given by the student. Biographies or books of travel offer excellent material.

4. Teachers may be able to grade the work of the fifth and sixth years after consulting the *Four Years' Course in French and Spanish for Secondary Schools* issued in April, 1914, and thus prepare students for further study in upper-division courses of the University.

Equipment

The most important books for a working library may be found in the bibliographies of the following works:

French: Gustav Lanson, *Histoire de la littérature française,* or F. Brunetière, *Manual de la littérature française.*

Spanish: Fitzmaurice-Kelly, *Histora de la literatura española.* (1914).

The annual cost of the maintenance of a working library depends on the condition of the library at the start. One hundred dollars per year would be necessary for the purchase of French books and seventy-five dollars for Spanish books to maintain a library on a satisfactory scale.

ZOOLOGY

Courses Suitable for Junior Colleges

1A. General Zoology.

An introduction to the facts and principles of animal biology, with special reference to the evolution of animal life.

Lectures 2 hrs., laboratory 4 hrs., first half-year; 4 units. The laboratory exercises are essentially illustrative of lectures and are based on the examination of living and prepared specimens, supplemented by models and charts.

1B. General Zoology.

A continuation of course 1A. A study of the behavior, structure, and development of animal types, with special reference to the lower vertebrates.

Lectures and recitations 2 hours, laboratory 4 hours, second half-year; 4 units.

The first year's work might well cover the following main subjects:

I. Cytology.
   1. The living substance, its physical, chemical, and biological properties.
   2. Cell division, and functions of cell organs.
   3. Reproduction, sex and somatic cells.
   4. Maturation and fertilization, their significance in heredity.

II. Development.
   1. General embryology, origin, derivatives, and differentiation of the germ layers.
   2. Elementary organology.

III. Histology—Main types of tissues and their functions.

IV. Organology.
   1. Organ systems in the animal kingdom treated from the genetic point of view.
   2. Structure and function of typical organs in each organ system.

V. Brief systematic description, and morphological treatment of the phyla of the animal kingdom, with emphasis upon types illustrative of fundamental principles.

VI. Economic Zoology. Relations of animals to health of man and animals, to agriculture and to industry and commerce.

VII. Special consideration of the vertebrate type as a basis for higher study and in relation to man.
   1. Anatomy of the shark and amphibian, including a detailed study of all organ systems.
   2. Embryology of the amphibian to metamorphosis.

VIII. Evolution and Heredity.
   1. Mendel's laws.
   2. Direct action of the environment.
   3. Selection.
   4. Geographical distribution.
   5. Principles of plant and animal breeding.
   6. Eugenics.

Equivalents to the course outlined above in scope, extent, purpose, and quality are acceptable. Departures from this outline are possible and may be desirable locally. The department at Berkeley stands ready to co-operate by way of advice as to materials and modifications desirable from the standpoint of local conditions. The laboratory guide (Syllabus 50, General Zoology, University of California Press, 1914) in use at Berkeley indicates more fully the scope and method of the work and the types employed. It may be obtained from the University of California Press, Berkeley; price 50 cents.

The department of Zoology will be glad to co-operate with the junior colleges in any other ways that will be helpful in the development of their zoological instruction. It would be of especial advantage to those students who continue the study of the biological sciences in the University to have had the equivalent of Zoology 1A and Zoology 1B. These form the prerequisite for most of the other courses in the Department of Zoology.

During vacations the services of trained assistants from the University may often be secured, who will be prepared to install a complete equipment for such a course, both in respect to apparatus and materials for study.

Equipment

Suggestions in regard to particular features of laboratory equipment will be freely given. Reference may be made to chapters on the outfitting of a laboratory in Lloyd and Bigelow, *The Teaching of Biology* and Ganong, *The Teaching Botanist.*

The following list of furniture and apparatus will afford a substantial equipment for the year's work, and even more, as above outlined, for a class of twelve, or more if the class is divided into sections. Some of the equipment, such as microscopes, microtome, laboratory furniture, some of the glassware and chemicals, may be used jointly in classes of botany* and zoology if teaching staff, schedule and rooms permit. A competent and experienced teacher can do much with a smaller equipment than that here indicated, but for the best work of university grade the equipment here outlined, or its equivalent, should be provided or built up as rapidly as means permit.

Equipment of Laboratory

Class of twelve or more if sections are established

3 laboratory tables to seat four students each	$66.00
12 laboratory stools, adjustable	18.00
12 laboratory lockers for microscopes	40.00
Models (lists on application)	$50.00 to 100.00
Charts, Pfurtscheller and Chun and Leuckart (selected list on application)	100.00
Entomological supplies (list on application)	50.00
Glassware and aquaria (list on application)	$100.00 to 200.00
Chemicals (list on application)	50.00

* See estimate of Department of Botany above, p. 28.

Alcohol, 1 barrel	30.00
Accessory apparatus (list on application)	100.00
Formalin, 1 barrel	44.00
Work trays and storage containers	30.00
Microscopes, 10 at $45.00, 2 at $65.00	580.00
Microtome	36.00
Double eyepiece	18.00
3 binocular microscopes at $55.00	165.00
Paraffine bath	$10.00 to 40.00
Slides and preparations	125.00
Teaching collection (list on application)	100.00
Reference library, 100–175 volumes (list on application)	$250.00 to 500.00
Total	$1982.00 to $2392.00

Berkeley, July, 1915.

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